

BMD Technology Program Overview



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DTIC QUALITY INSPECTED 4

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TECHNOLOGY PROGRAM GOALS

Threats And Technology Do Not Stand Still, Therefore

- Support Missile Defense With Component Technology Improvement

<u>Increase</u>	<u>And</u>	<u>Decrease</u>
-----------------	------------	-----------------

- | | | |
|-----------------|--|----------|
| • Range | | • Size |
| • Lethality | | • Cost |
| • Accuracy | | • Weight |
| • Effectiveness | | |
| • Producibility | | |

- Pursue Advanced Concepts For Future Responses To An Evolving Threat
 - New Kill Mechanisms
 - High Payoff (Boost-phase Intercept)

**The Key To Improved Performance And Cost
Reduction Is Technology Innovation**



TOWARDS A BALANCED TECHNOLOGY PROGRAM

Balanced Technology Investments (6.2, 6.3)

Near-term Technology Infusion

- Cost Reduction
- Risk Reduction
- Shorten Development Timelines

Advanced Technologies (Preplanned Product Improvement; New Systems)

- Countering Advanced Threat
- Reduce Cost / Risk
- Increase Effectiveness
- Support Special Missions

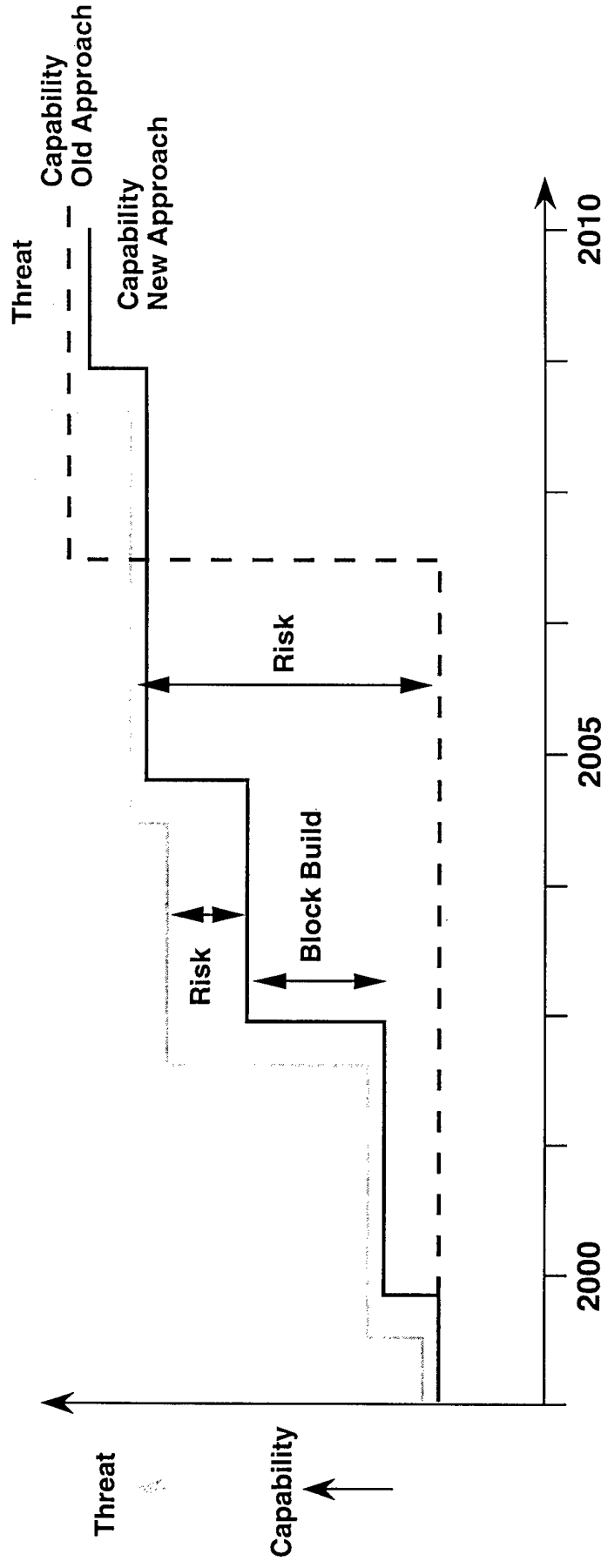
Innovative Science And Technology

- Revolutionary Technologies / Processes
- Future Architecture / Operational Concepts



OPPORTUNITY – MATCHING ARCHITECTURE TO THE THREAT

Notional Threat



- Use Continuous Building Block Approach
- Deliver Warfighting Capability Now To Meet Today's Threat
- Lay Out Continuous Implementation / Technology / Funding Road Map To Meet Tomorrow's Threat



FACILITATING COST SAVINGS ACROSS THE JOINT MISSION AREA

Challenges

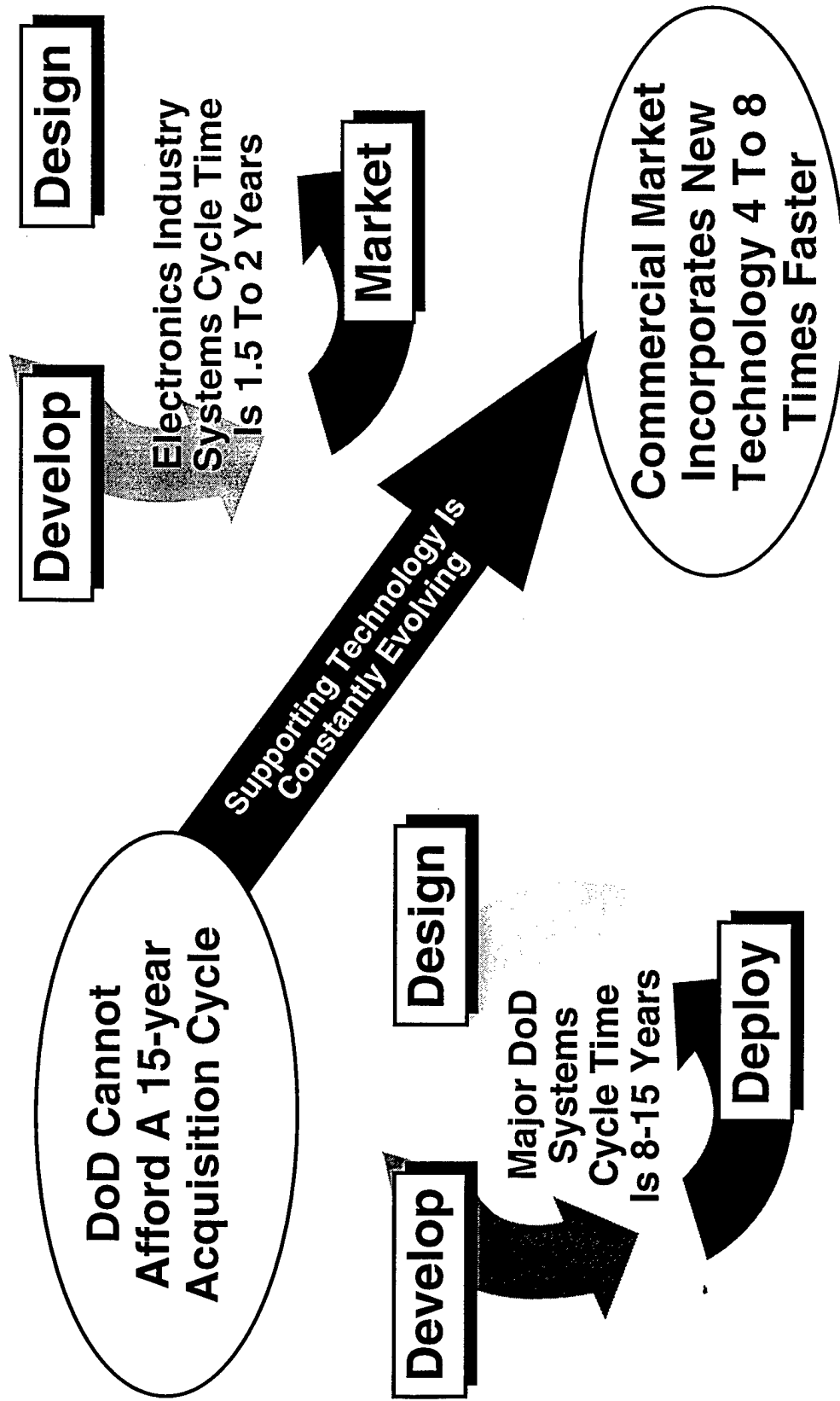
- Redundant Capabilities
- Proprietary Technologies

Opportunities

- Define And Implement Open Systems Approach To Hardware Development
 - Plug And Play Modules For Future Architecture / Systems To Lower Cost, Facilitate Interoperability, Reduce Proprietary Solutions
- Rethink The Management Of Risk Reduction Technology Development Programs
 - Focus On Joint Solutions
 - Architecture And System-level As Opposed To Service / Platform Specific



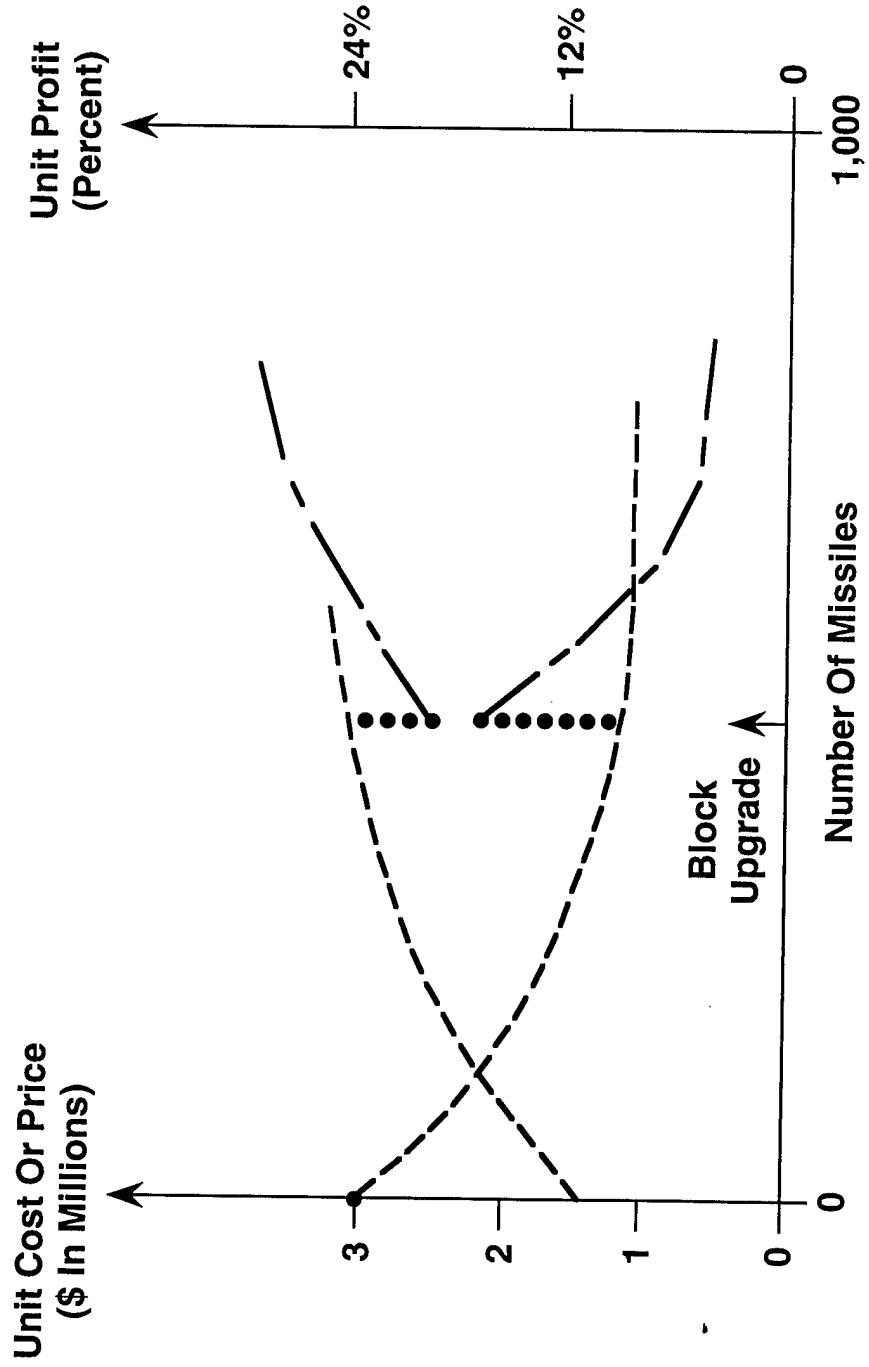
NEAR-TERM TECHNOLOGY INFUSION





NEW APPROACH

Lean Missile Initiative





PROPOSED NEAR-TERM TECHNOLOGY INFUSION PROGRAMS

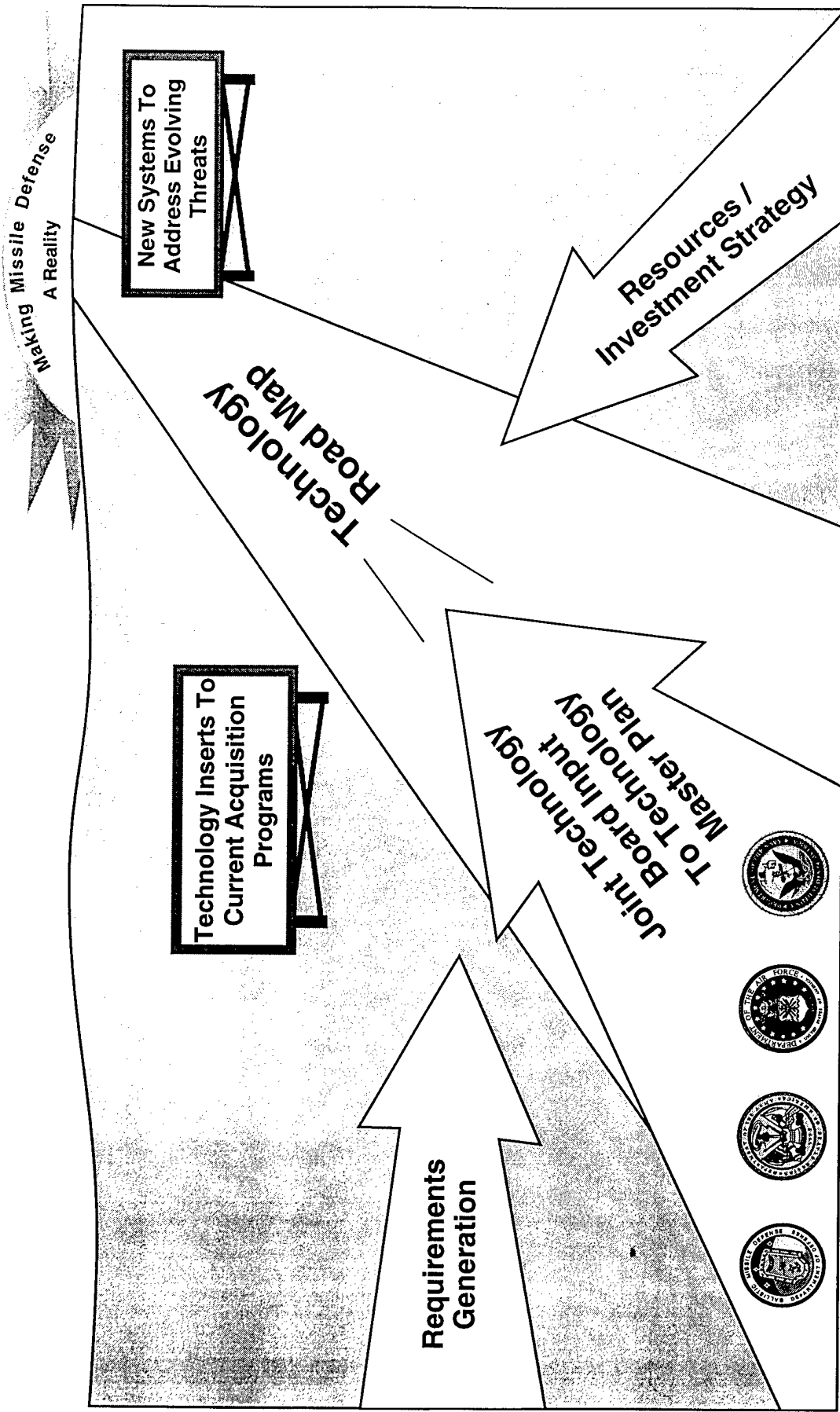
Materials And Structures (Cooperation With Affordable Multi-Missile Manufacturing Program (AM3))	<ul style="list-style-type: none"> • <i>Polymer Matrix Composites*</i> • Metal Matrix Composites • Advanced Ceramics For Manufacture Of Radomes / Shrouds • IR Windows
Propulsion	<ul style="list-style-type: none"> • <i>Component Development / Manufacture For DACS**</i> • Energetic Propellants For TMD / NMD Sustainer Engines / DACS
Sensors (Cooperation With AM3)	<ul style="list-style-type: none"> • <i>Family Of Interferometric Gyro-based INS Systems For Interceptors*</i> • Transmit / Receive Module Cost Reduction • <i>Solid-state Transmitter For PAC-3 / MEADS**</i> • Focal Plane Array Producibility • <i>Master Frequency Generator*</i>
Signal Processing Electronics (Cooperation With AM3)	<ul style="list-style-type: none"> • COTS-based Radar Architectures • <i>Advanced Signal Processing For Seekers / Radars / Electro-Optics**</i>
BM/C ³ Hardware	<ul style="list-style-type: none"> • Large, Ruggedized Displays For BM/C³ Centers • Asynchronous Transfer Mode Communications • Microwave Power Modules
Batteries	<ul style="list-style-type: none"> • Advanced Thermal / Lithium Batteries

* Ongoing Project

** Proposed 1999 Project



TECHNOLOGY PROGRAM PLANNING





TECHNOLOGY MASTER PLAN OBJECTIVES

- Greater Understanding Of The Evolving Threat And Mission Essential / Enabling Capabilities
- Develop Technologies That Keep Pace With The Threat, Reduce MDAP Costs, And Mitigate Risk
- Identify Timelines For Technology Development
- Align Existing Technology Programs, Leverage Service Technology Programs, And Develop New Technology Programs To Meet FoS And NMD Needs
- Determine Level And Timing Of Required Financial Resources

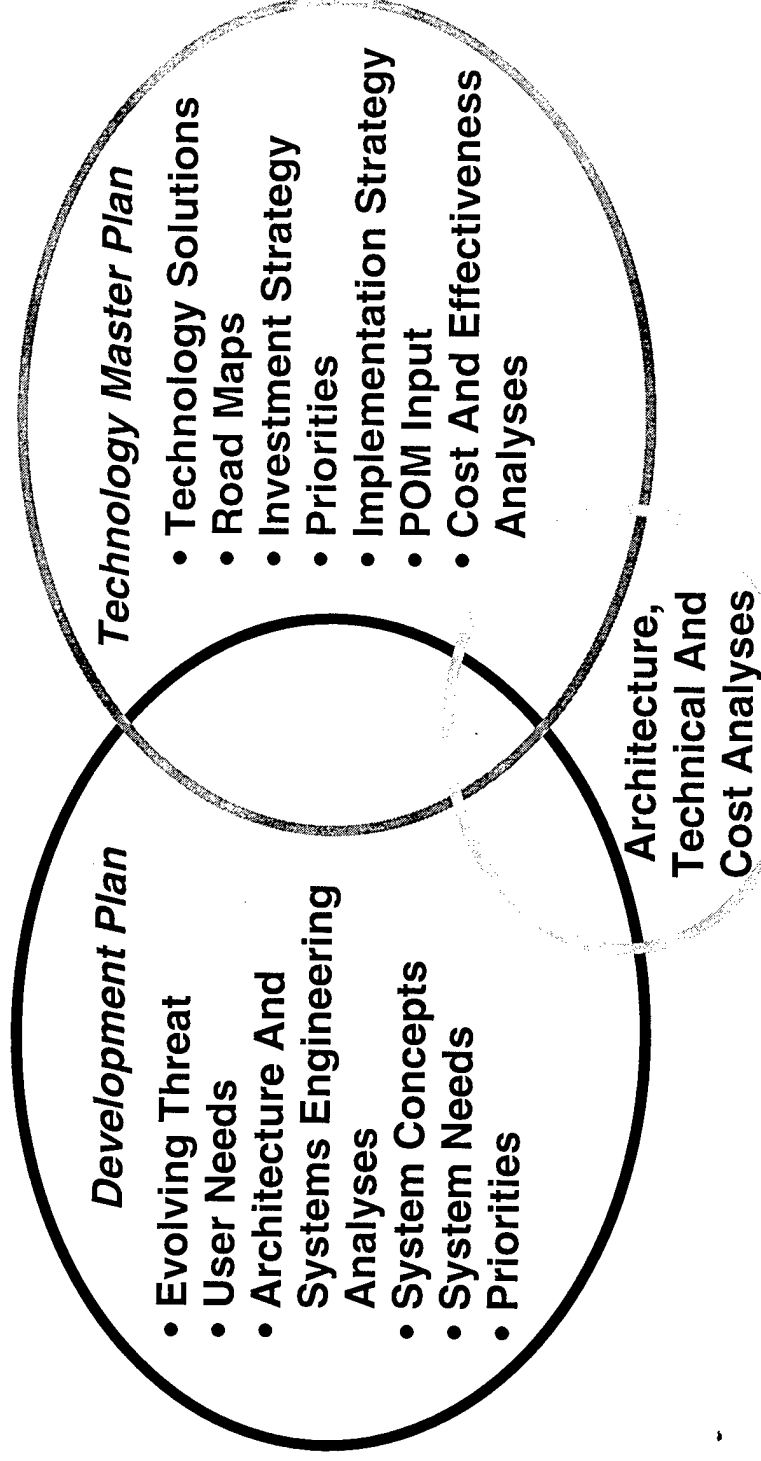
It Is Not Uncommon For People To Equate R&D With The Development Of Hardware, A View Which Is As Limited As It Is Erroneous. The Product Of The R&D Effort Is An Operational Capability. Weapons Hardware Is But One Subsystem Of Operational Capability. This Point Must Be Reemphasized; The Objective Of R&D Is Operational Capability, Not Hardware *Per se.*

DON RDT&E / Acquisition Management Guide



BMDO PLANNING FOR TECHNOLOGY INVESTMENT

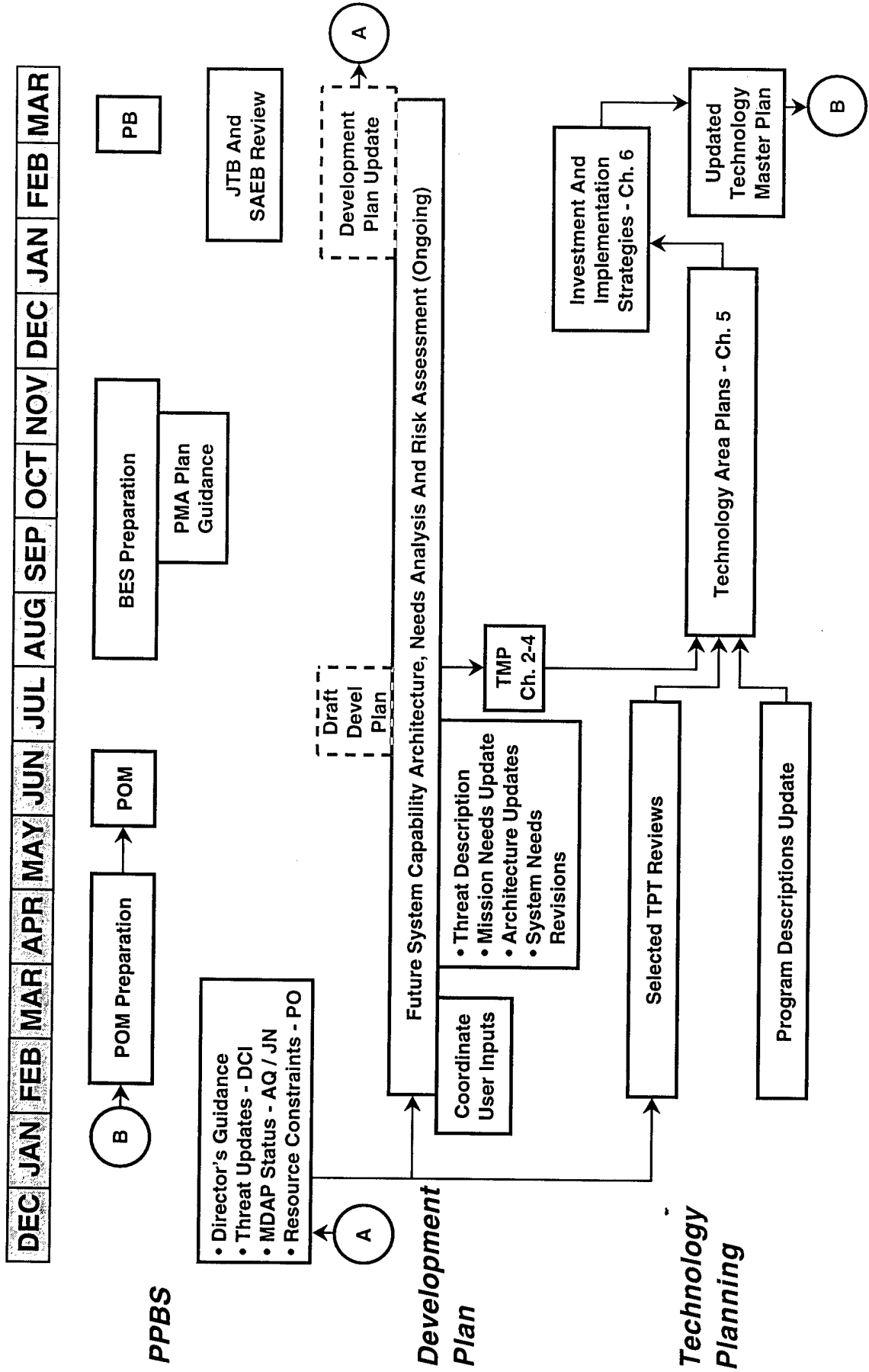
The Development Planning Process Provides BMDO's System Needs For Technology And Basis For Investment



The Technology Master Plan Defines BMDO's Investment And Approach To Obtaining The "Needed" Technology



ANNUAL TMP PROCESS





CHALLENGE: INVOLVING THE CONTRACTOR COMMUNITY

- **Government-Industry Open System Applications Group**
 - **Strategic Partnership With DARPA Affordable Multiple Missile Manufacturing (AM3) Program**
 - **Initial Meeting Held 18 MAR 98**
- **Establish Best Practices And Standards For**
 - **Key Hardware Components**
 - **Examples: Guidance And Control, T / R Modules, Propulsion, Materials And Structures, Signal Processing Electronics, etc.**
 - **Grow To Include Key Software Applications (Treat As Components)**
 - **Examples: BM/C³, Hit-To-Kill Guidance, Discrimination, etc.**
 - **Extend To Include Key Infrastructure Elements**
 - **Examples: M&S, Testing, Data Analysis And Handling, etc.**



INDUSTRY REVIEWS

- **TMP Coordinator Will Schedule Industry Meetings Through The GOSAG**
 - **BMDO Programs Will Be Presented To Industry**
 - **Two-way Exchange Of Information On Programs, IRAD, And Technology Needs With Each Individually**
 - **TPT Cochairs And Industry Representatives Will Attend**



TECHNOLOGY PLANNING TEAMS (TPT)

- **TPT Areas**
 - **Interceptors**
 - **Surveillance**
 - **BM/C⁴I***
 - **Directed Energy***
- **Responsibilities**
 - **Identify Programs That Meet Technology Needs**
 - **Develop Technology Area Plans**
 - **Tailor Or Leverage Existing Programs Where Possible, Otherwise Recommend New Starts**
 - **Produce Technology Road Maps**
 - **Prioritize Technology Programs**

*** Formed 1998**



TECHNOLOGY PROGRAM APPROACH

Threat	Stressed BMD Function	System Need For Technology	Technology Focus
<ul style="list-style-type: none"> • Penails <ul style="list-style-type: none"> - Jammers - Flares - LREPs - Aerosols - Coatings - Chaff 	<ul style="list-style-type: none"> • Discrimination • Kill Assessment • Track And Track Accuracy 	<ul style="list-style-type: none"> • RF / IR Discrimination • Signature Characterization • Multiple Sensor Data Fusion • TOM Generation • High Performance Data / Signal Processing 	<ul style="list-style-type: none"> • Integrated Active / Passive Seeker • Multicolor Seeker (IR) • Laser Radar / Interrogator / Imaging Ladar • Discrimination / Sensor Fusing Algorithms • Wave Front Sensing • Wideband Radar Processing • High-power / Efficiency T/R Modules • High-G Divert • BM Logic For Object Sampling
<ul style="list-style-type: none"> • Advanced Submunitions 	<ul style="list-style-type: none"> • Intercept Timeline 	<ul style="list-style-type: none"> • Surveillance • Boost Phase Intercept <ul style="list-style-type: none"> - Kinetic Energy - Directed Energy • Multiple Sensor Data Fusion 	<ul style="list-style-type: none"> • Cooled Window • Wide Field Of Regard Seeker • Plume / Hard Body Aim Point • Blended Aero / Divert • Typing • Detection / Background Suppression Algorithms • Wave Front Sensing • Multispectral Sensor Fusion • High-power / Efficiency T/R Modules
<ul style="list-style-type: none"> • Way Point Navigation • Multi-axis Attacks • Very High-G Maneuver • Reduced RCS (VLO) • Very Low Altitude 	<ul style="list-style-type: none"> • Lethality • Maneuverability • Minimum Intercept Altitude • Surveillance • Battle Management • Affordability 	<ul style="list-style-type: none"> • Safe High Performance DACS • Traffic Handling • Lower Tier Discrimination • Processing And Algorithms • Reduced Life Cycle Cost 	<ul style="list-style-type: none"> • High-G Fast Response Divert • Maneuvering Target Algorithms • Wide Field Of Regard Seeker • Fast Frame FPA / On FPA Motion Detector • RF / IR Apertures • Blended Aero / Divert Control • Real-time Data Processing / Fusion • High-power / Efficiency T/R Modules • VLWIR Multiple Quantum Well FPA • Waveform Sensing



INTERCEPT FOCUS AREAS

- **Atmospheric Interceptor Technology (AIT)**
 - Advanced Lower Tier Intercept Technology
 - Endoatmospheric Seekers, Windows, Interceptor Agility, Safe DACS, Optimal Guidance, Estimation Of Target Maneuvers
- **Exoatmospheric Interceptor Technology (EIT)**
 - Advanced Technologies For NMD And TMD Upper Tier
 - Multicolor Focal Plane Arrays, Laser Radar, Advanced Processors, Algorithms
- **Boost Phase Intercept (BPI)**
 - Target State Estimation Sensors And Algorithms, Missile Plume To Hard Body Handover



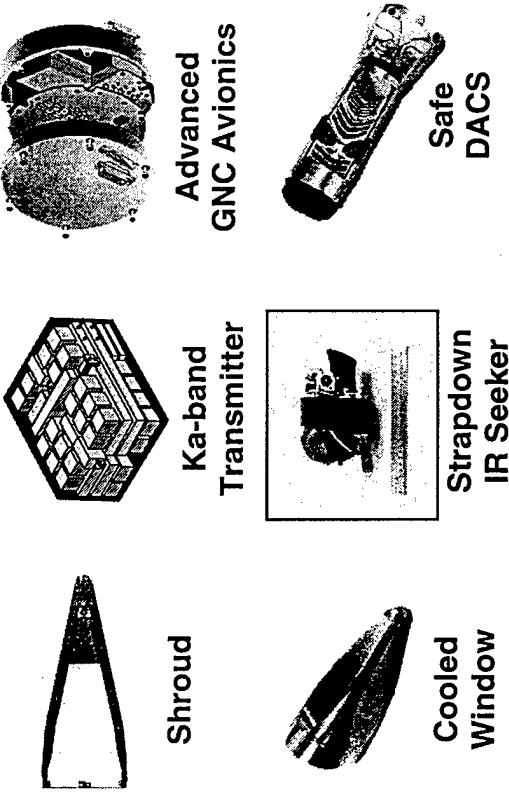
TMP TECHNOLOGY AREAS

- **Atmospheric Interceptor Technology (AIT)**
- **Exoatmospheric Interceptor Technology (EIT)**
- **Boost Phase Intercept Technology (BIT)**
- **Advanced Radar Technology (ART)**
- **Advanced Passive Technology (APT)**
- **Advanced Mission Technology (AMT)**
- **BM/C⁴I Advanced Technology (BAT)**
- **Directed Energy Technology (DET)**

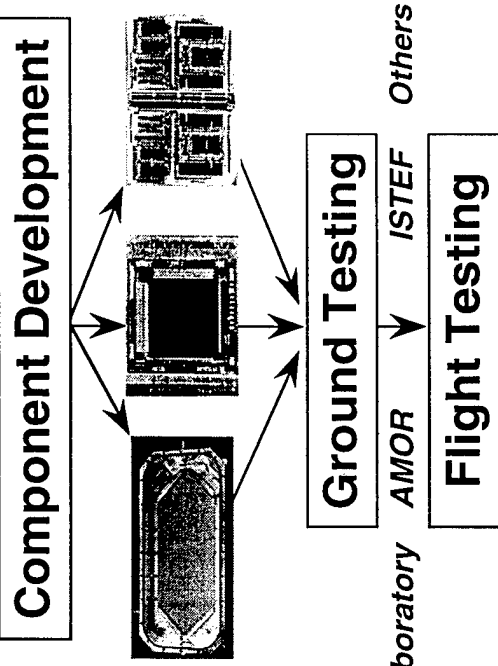


INTERCEPT INTEGRATED TECHNOLOGY PROGRAMS

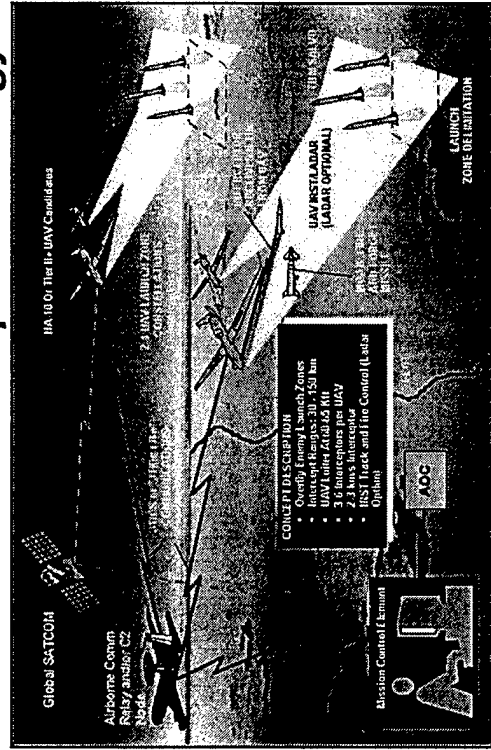
Atmospheric Intercept Technology



Exoatmospheric Intercept Technology



Boost Phase Intercept Technology



• The BMDO Technology Master Plan (TMP) Is The Foundation For Restructured Intercept Technology Programs

• Intercept Technologies Are Better Tied To MDAP Needs

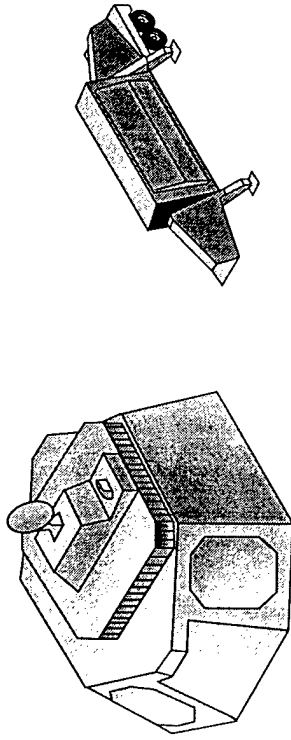
• New Technologies Will

- Respond To Evolving Threat
- Enhance Current MDAP Performance
- Improve Affordability / Reliability

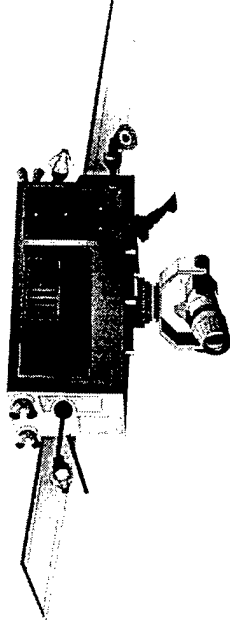


SURVEILLANCE INTEGRATED TECHNOLOGY PROGRAMS

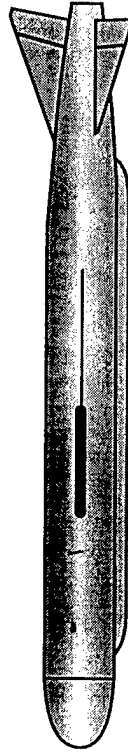
Advanced Radar Technology (ART)



Advanced Passive Technology (APT)



Advanced Mission Technology (AMT)



- The BMDO Technology Master Plan (TMP) Is The Foundation For Surveillance Technology Programs
- Surveillance Technologies Are Directly Tied To MDAP Needs
- Technology Efforts Will
 - Meet Current MDAP Requirements
 - Respond To Evolving Threat
 - Improve Affordability / Reliability

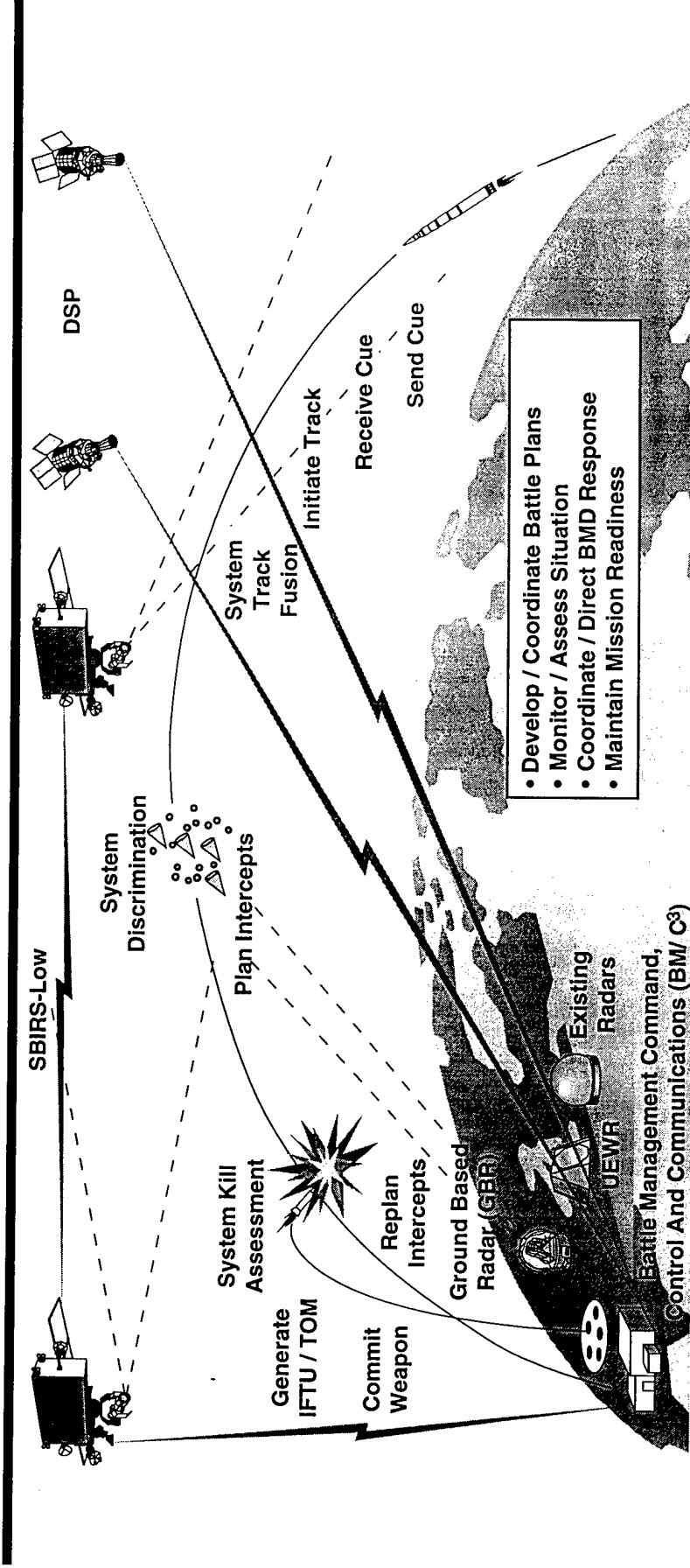


SURVEILLANCE FOCUS AREAS

- **Advanced Radar Technology (ART)**
 - Increased Power Aperture And Beam Agility, Enhanced Waveform Design
 - Low Cost T / R Modules, Improved Processors, Advanced Algorithms
- **Advanced Passive Technology (APT)**
 - Advanced Components For Satellite Surveillance, Acquisition, Track, Discrimination, Kill Assessment (SATDKA)
 - Improved FPA Uniformity, Longer Wavelengths, Optics Cleaning, Cryocoolers, Radiation Hardened Electronics
- **Advanced Mission Technology (AMT)**
 - SATDKA Functions For Cruise Missile Threat



BM/C4I ADVANCED TECHNOLOGY (BAT)



Defense Against Strategic Ballistic Missiles

- The BMDO Technology Master Plan (TMP) Is The Foundation For Restructured BM/C4I Technology Programs
- BM/C4I Technologies Are Tied To MDAP Needs
- New Technologies Will
 - Improve Battle Management In Response To An Evolving NMD / TAMD Threat
 - Enhance Current MDAP Performance And Improve Affordability / Reliability
 - Address Advanced Mission Threat Battle Management



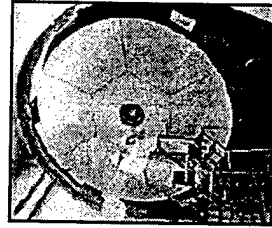
BM/C⁴I FOCUS

- **BM/C⁴I Advanced Technology (BAT)**
 - **Use Open Systems Standards, Leverage Communications Infrastructure**
 - **Battle Management Technology, Situation Awareness, Kill Assessment, Evaluation Tools**

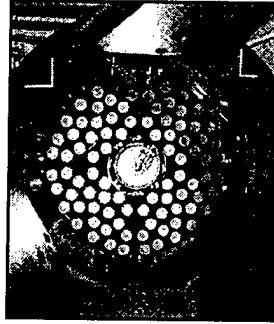


DIRECTED ENERGY TECHNOLOGY DEVELOPMENT CONCEPT

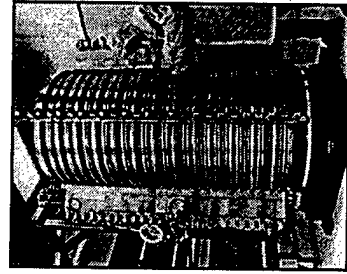
Demonstrated Technologies



Large Optics
(LAMP, 1989)



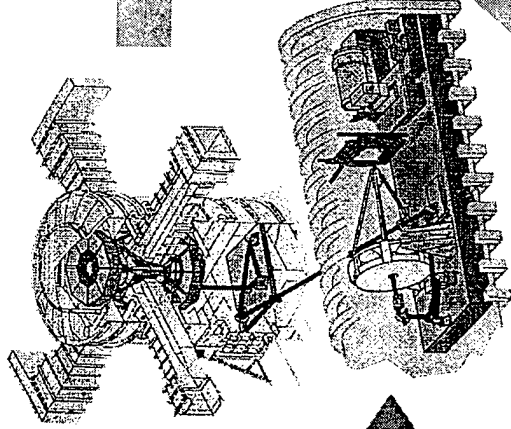
Beam Control
(LODE, 1987)



Laser
(Alpha, 1991)

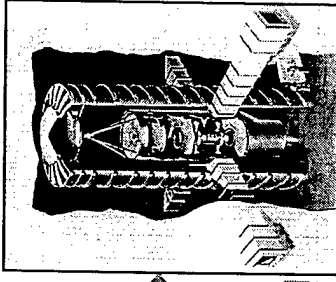
Integration

Alpha LAMP Integration (ALI)
End-to-end Weapon Element Testing

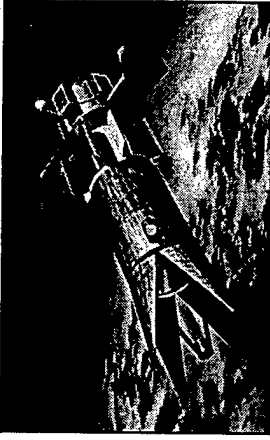


System-level Development

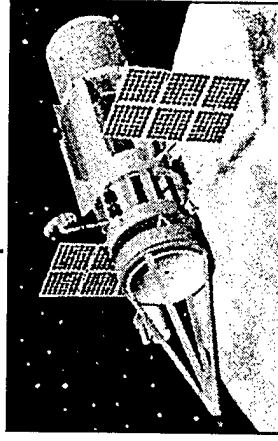
Integrated Ground Demonstrator (IGD)



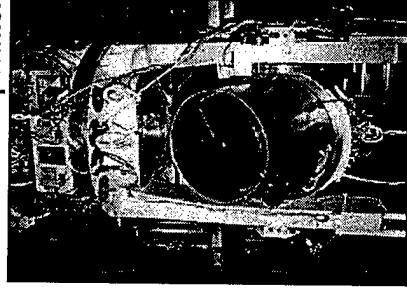
Integrated Flight Experiment (IFX)



Future Operational SBL



*Acquisition Tracking, Pointing
And Fire Control
(High Altitude Balloon Experiment (HABE))*





DIRECTED ENERGY FOCUS

- **Directed Energy Technology (DET)**
 - **Integrated Technology For Space Based Laser Integrated Flight Experiment (IFX)**
 - **Precision Pointing, Waveform Sensing Adaptive Optics, Advanced Beam Generation**



RESEARCH / EXPLORATORY DEVELOPMENT (IS&T, SBIR)

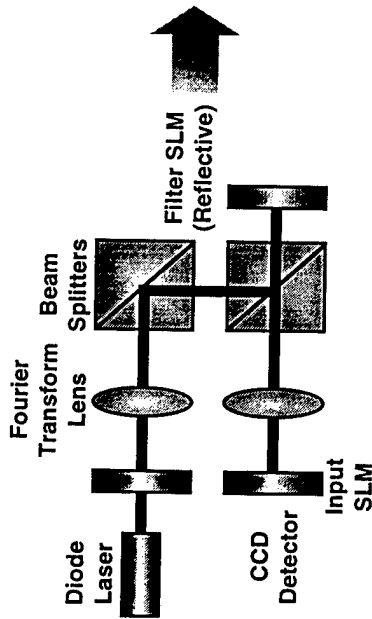
- **Innovative Science And Technology (IS&T)**
 - **Research And Exploratory Development Targeting Breakthrough Technologies For Ballistic Missile Defense**
 - **Core R&D Program In Sensing, Directed / Kinetic Energy, Materials, Propulsion, Power, And Information Processing**
- **Small Business Innovative Research (SBIR)**
 - **Mandated Percentage Of Extramural R&D**



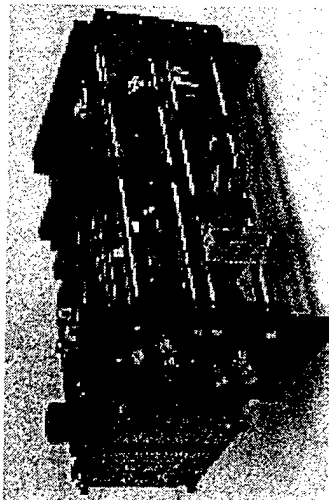
INNOVATIVE RESEARCH – HIGH RISK TECHNOLOGY FOR BMDO'S FUTURE

Development Of Grayscale Optical Correlator

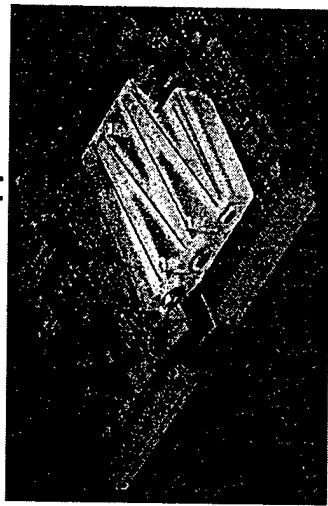
Optical Correlator Schematic



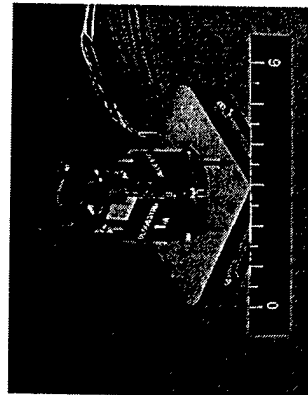
BMDO Funded Camcorder-sized
Grayscale Optical Correlator
JPL – 1998



Matchbox-sized Optical
Correlator To Be Delivered For
DoD And NASA Applications

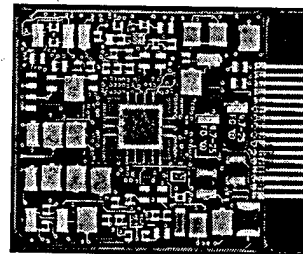


1998 INS / GPS

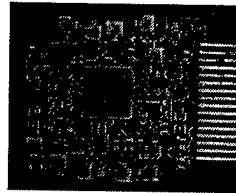


6-dof ISA
3 cu in

MEMS Gyro Instrument Progression



1997
0.47 cu in
Commercial Gyro



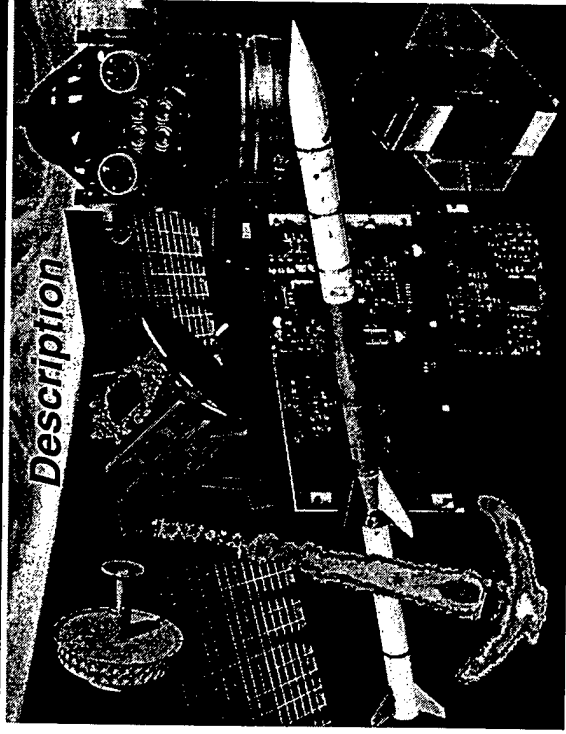
1998
0.35 cu in
High Performance Gyro



1999
0.17 cu in
High Performance Gyro



INNOVATIVE SCIENCE AND TECHNOLOGY



Issues

- Rapid, Drastic Funding Reductions Are Devastating To Innovative Research And Will Limit BMDO's Ability To Meet Advanced Threats
- Current Program Supports Several Key Technologies And Closes Out Many Others, No Significant New Starts
- Funding Reductions In Opposition With Recent Congressional Language

Benefits / Applications

- Keeps BMDO On "Cutting Edge" Of Technology, BMDO's Investment In The Future
- Identifies And Develops Key New Technologies To Meet Emerging And Far-term Threats
- Provides Innovative Upgrades For Existing Systems
- MDAP Relevance: Generic High Payoff Technologies For TMD/NMD/CMD Applications

Budget / Selected Products FY 00 PB (TY \$M)

FY 95	FY 96	FY 97	FY 98	FY 99	FY 00
\$80.00	\$65.00	\$52.00	\$52.82	\$22.98	\$7.86

- SCARLET Arrays And Hall Thrusters For SBIRS-class Programs
- Advanced Thermal Batteries For THAAD
- Lasercom For Rapid, Secure Communications
- Miniature Interceptor Technology For Advanced Submunitions
- Advanced Sensors / Sugar Cube Processor / Neural Net Algorithms For BMD / CMD ATR



IMPLEMENTATION STRATEGY

- **Based On Director's Guidance To Allocate 10% (Minimum) – 12% (Goal) Of BMDO Total Obligational Authority To Technology Development**
 - **Includes Set-asides (e.g., SBL Readiness Demonstrator, SBIR)**
- **Consistent With Technology Priorities**
 - **Solution Or Mitigation Of A Critical Challenge**
 - **Cost Reduction**
 - **Multiple Potential Applications**
 - **Breakthrough Technologies**



A NEW APPROACH

- **Building Consensus Requires New Approach**
 - **Relate Technology Programs To Military Deficiencies, Technology Needs And Operational Capability**
 - **Establish Process For Corporate Participation And Decision Making**
 - **Develop A Product To Guide And Coordinate Missile Defense Technology Programs**
- **The Technology Master Plan Process Incorporates This Paradigm Shift**



SUMMARY

- **BMDO TMP Is The Vehicle For Implementing Director's Guidance For Technology**
 - **Maintain U.S. Technical Superiority In Missile Defense**
 - **Relate BMDO Technology To MDAP Needs And Operational Capabilities**
 - **Allocate A Goal Of 12% Of TOA, But Not Less Than 10% For BMDO Technology Program**
 - **Maximize Participation Of Missile Defense Community In BMDO Technology Program**